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GÉNÉRALES D'ÉLÈCTRICITÉ ET DE

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54 Semi-duplex modem for GSM radiotelephone network.

57 The modem can receive digital data 12 and transform them into analog data 14 of the same type as the one for voice and designed to be processed by a GSM codec. The modulator part 1 includes a logic gate circuit 5, a series of frequency generators 6-9, a multiplexer 10 and a time-varied amplifier 11.

- The modem allows the attachment of IWF units to the GSM network.

Fig. 1

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The GSM (Group Special Mobile System) network allows the intercommunion of mobile radiotelephones between each other as well as between a radiotelephone and a normal phone through the STN (Switched Telephone Network) network.

With a GSM radiotelephone, the handset transmits analog vocal data, which is then transformed by an encoder-decoder (Codec) into a 14 kbits/s digital flow for transmission on broadcast channel. This flow, on the ground-based part of the GSM network, is transformed into 64 kbits/s, for intercommunication with the STN network. The STN network, in its main infrastructure, carries the telephone signal of 300 to 3400 Hz in a digital form through sampling at a frequency of 8 kHz, at a rate of 8 bits per sample, which represents a data flow of 64 kbits/s.

The GSM codec was designed to transmit voice and is not well suited to the transmission of modem data (modulators-demodulators).

However, the STN network is routinely used for the transmission, other than voice, of modem signals transmitting data occupying the same 300-3400 Hz band. In

order to offer the same service on the GSM network, it was anticipated that the transmission of data on GSM would take place digitally, which leads to a better usage of the spectrum and to a stronger transmission.

Consequently, a data transmission mobile GSM transmits digitally, at specified rates determined by the GSM standards; for example, 9600 or 4800 bits/s. At the intercommunion level with the STN network, with the help of IWF (interworking functions) units, including series of modems following the CCITT standards, the digital data is transformed into analog signals.

Such a digital transmission is satisfactory for the intercommunion of two mobile radiotelephones between each other, but it has some inconvenients.

First, to communicate with data transmission terminals on the STN network, the interworking functions must be available on the GSM. Second, the transmission is limited to the usage of normalized modems, which, furthermore, do not insure a complete confidentiality of transmission. However, two parties can very well want to control the

modulation system from one end to the other and use specific protocols adapted to the global error rate as well as to the application. The same goes for the transmission of short messages within a fleet of vehicles, and typically, for the transmission of a large quantity of information or low rates.

This invention is designed to circumvent these inconvenients, meaning, and possibly, to attach IWF units of the GSM network.

For this purpose, this invention concerns a semi-duplex modem characterized by the fact that it is tailored to receive digital data and to transform them into analog data of the same type as the one for voice and designed to be processed by a GSM codec or vice-versa.

The data transmitted by the modem of the invention looks like voice data, without actually being some, which allows the parties to intrude on voice circuits on the GSM network and thus avoid the inconvenients of the IWF units.

Consequently, and for example, the modem of the

invention can be substituted to the microphone and speaker of a GSM radiotelephone and serve as interface between such a radiotelephone and a telematic terminal with screen and keyboard, for commercial use. The digital data from the terminal of a subscriber is transformed, inside the modem, in pseudo analog voice data, crosses the codec of the radiotelephone and comes out at a transposed rate of 14 kbits/s in the GSM network at 64 kbits/s without having to go through the IWF units before crossing the STN network and arrives in the telematic terminal of another subscriber, with a transparent communication from one end to the other between the two subscribers.

We must point out that the invention, ultimately, goes against the technical evolution we have seen up to now.

In the preferred production form of the modem of the invention, amplitude-modulated means and/or low rate frequency are provided, appropriately at 300 bauds. The resulting signal is thus equipped of characteristics similar to the ones associated with the human voice, as far as the GSM codec is concerned. Conversely, a high rate and

the phase modulation, usually adopted in performing modems, do not cross the GSM codec very well.

Again, preferably, the modem of the invention has means of generating signals of a frequency chosen among many, preferably four, and an amplitude also chosen among many, preferably two. The modem then converts input digital data into output signals chosen between eight (2^3), either on three bits and eight states by baud, with a total rate, in the case of a modulation rhythm of 300 bauds, of 900 bits/s.

The invention will be better understood with the help of the following description of two forms of production, in reference to the drawing attached on which:

- The figure 1 is a schematic representation in blocs of the modulator of the first form of production of the modem of the invention.
- The figure 2 is a schematic representation of the demodulator of the first form of production of the modem of the invention.
- The figure 3 is a schematic representation of the

modulator of the second form of production of the modem of the invention.

- The figure 4 is a schematic representation of the demodulator of the second form of production of the modem of the invention.

The modulator 1 of the semi-duplex modem of figure 1 includes a clock 2, a shift register 4, a logical gate circuit 5, a series of four frequency generators 6-9, a multiplexer 10 and a varied gain amplifier 11.

In the example considered, the modulator can supply eight states corresponding to four frequencies and two amplitudes. The two amplitudes corresponding to two different gains A^1, A^2 of the amplifier 11, here 1 and 2. The four frequencies of the four generators 6-9 are here, but they could be different, f1 = 900 Hz, f2 = 1100 Hz, f3 = 1300 Hz, f4 = 1500 Hz, generating a spectrum perfectly compatible with the passing band of the STN normal switched telephone network, which varies from 300 to 3400 Hz, and with the response in pure frequency from the GSM codec (known to surpass 2000 Hz), allowing, in between the GSM

and STN networks, to associate two telematic terminals from a subscriber caller and a subscriber called connected to one or the other of the two networks.

The clock 2 supplies here 900 bits per second. The bits from the input digital signal 12 are consolidated in packs of three, or tribits, through a register 4 receiving the bits in serial at 900 bits/s and by repeating them in parallel in a register 4′ at a rate of 300 Hz supplied by the divider 3. The last two bits proceed with the selection of the frequency, conducted in the gate circuit 5, connected to register 4′, according to the following table:

[Table]

00	f1
01	f2
10	f3
11	f4

to order the start up of the generators 6-9.

The first bit proceeds with the selection of the amplitude and orders the gain of the amplifier 11.

Consequently, the first cell of register 4 is connected to the gain order of the amplifier 11, the last two cells,

to the gate circuit 5.

Please take note that the grouping of the input bits into tribits is conducted without phase reference, which is not significant in any way. Similarly, it does matter if a 0 or 1 bit orders a gain 1 or 2 from the amplifier 11. The demodulator of the modem of the subscriber called in fact recuperates the clock signal 13 of the clock 2 and the demodulation is carried out exactly following the reverse steps of the modulation.

The signal supplied by one of the generators 6-9, which crosses the multiplexer 10, is amplified, according to one or the other of its two gains, by the amplifier 11, which supplies the output signal 14.

The demodulator 15 of the first form of production of the semi-duplex modem in figure 2 includes a gain automatic control circuit 16, which is connected to an amplitude detector 17 and a clipper 18, and receives the input signal 21. The detector 17, connected to a clock extractor 20, supplies the first amplitude bit, which is stored in the first cell of a shift register 19. The clipper 18 is

connected to the input of a frequency demodulator 22 whose output is connected to a threshold element 23 which supplies with two wires, connected to the extractor 20, the two frequency bits which are stored respectively in the last two cells of register 19. The extractor 20, known as such, proceeds with the extraction of the clock signal 24, at 900 Hz, here through phase locked loop. A clock signal 24′, at 300 Hz, causes the parallel copy of register 19 in a register 19′ that is emptied in serial at the same rate as the clock 24 at 900 Hz to establish the output digital signal 25.

The modulator 26 of the second form of production of the semi-duplex modem in figure 3 includes a clock 30, a clock divider 31, a shift register 32, a commercial modem V 21 with frequency modulation and specified delay, tagged 33 on the drawing, a variable gain amplifier 34, a delay line 35, between the register 32 and the amplifier 34, to create a delay equal to the one from modem 33.

In this second example, the modulator 26 is structured around a commercial modulator and supplies only four

possible states corresponding to two frequencies and two amplitudes possible. The modem 33, which can be, for example modem EF7910 from Thomson, can supply a modulated signal at 980 Hz and 1 180 Hz. The clock 30 supplies here 600 bits per second. The bits of the input digital signal 27 are consolidated by pairs through register 32, which receives them in serial at 600 bits/s and repeats them in parallel in a register 32′ at a rate of 300 Hz supplied by the divider 31, which divides by two. The last bit proceeds with the selection of frequency in the modem 33 and the first bit to the selection of amplitude and orders the gain of the amplifier 34, which supplies the pseudo analog voice signal 28.

The operation of the modulator 26 is identical to the operation of the modulator 1 and can only be differentiated by the replacement, by the commercial modem 33, of the gate circuit 5, of the series of generators 6-9 and of the multiplexer 10.

The demodulator 36 of the second form of production of the semi-duplex modem in figure 4 is very similar to the

demodulator 15 in figure 2, with a gain automatic control circuit 37, an amplitude detector 38, a clipper 39, a clock extractor 42 and two registers 41 and 41′, here with two cells. The demodulator 36, whose operation is identical to the operation of the demodulator 15, can only be differentiated at the structural level by the replacement, by a modem V 21, the same as modulator 26, tagged 40 in the drawing, of the frequency demodulator 22 and the threshold element 23, on one side, and the connection of a delay line 43 between the detector 38 and the extractor 42.

We have just described two modems converting input digital data into output signals chosen among numerous possible states corresponding to various modulation frequencies (4 or 2) and modulation amplitudes (2). Of course, we can ponder these frequency and amplitude parameters differently and, for example, discard the amplitude modulation completely.

Patent Claims

1. Semi-duplex modem characterized by the fact that it is built to receive digital data (12;27) and to transform them into analog data (14;28) of the same type as the one for voice and likely to be processed by a GSM codec or vice-versa.

2. Modem according to claim 1, in which amplitude modulation means are provided (4,4′,11; 32,32′,34).

3. Modem according to claim 2, in which a signal generation modulator (1;26) is provided at an amplitude chosen among many.

4. Modem according to claim 3, in which the modulator (1;26) includes an amplifier with two gains (11;34).

5. Modem according to one of the claims 1 to 4, in which means of signal generation in frequency are provided (4-10;32,32′,33).

6. Modem according to claim 5, in which a signal generation modulator (1;26) is provided at a frequency chosen among many.

7. Modem according to claim 6, in which the modulator (1) includes a logic gate circuit (5), a series of frequency generators (6-9) and a multiplexer (10).

8. Modem according to claim 6, in which the modulator (26) includes a commercial frequency modulator modem (33).

9. Modem according to one of the claims 1 to 8, in which the digital data (12;27) is received in a shift register (4;32).

10. Modem according to claim 7, in which a demodulator (15) is provided including a frequency demodulator (22) and a threshold element (23).

11. Modem according to claim 8, in which a demodulator (36) is provided including a commercial frequency modulation modem (40).

12. Modem according to one of the claims 10 and 11, in which the modulator (1;26) includes a clock (2;30) and the demodulator (15;36) includes two shift registers (19,19';41;41') operated by a clock extractor (20;42) with phase locked loop extraction.

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FIG. 1

FIG. 2

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FIG. 3

FIG. 4

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EUROPEAN RESEARCH REPORT

Application Number

EP 92 40 3185

DOCUMENTS CONSIDERED RELEVANT

[Left to right]

Category

Document quotation with indication, if necessary, of

relevant passages

Related claim

Classification of the request (Int. Cl.5)

French → English Publication Number: 0 545 783 A1

Stoel Rives LLP

X IEEE GLOBAL TELECOMMUNICATIONS

CONFERENCE & EXHIBITION GLOBECOM'89,

Dallas, Texas, November 27-30, 1989, Vol. 2, pages 1075-1079, IEEE, New York, USA; A. COLEMAN et al.: "Subjective performance evaluation of the RPE-LTP codec for the Pan-European cellular digital mobile radio system"

* Page 1075, left column, lines 11-12, 32-36; page 1077, right column, line 21; page 1078, left column, line 19 *

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H 04 L 27/32

H 04 Q 7/04

Y IBID

2-12

Y US-A-4 015 204 (K. MIYAZAWA)

* Abbreviated; Figure 9-13, 15-17; column 1, line 30; column 2, line 16; column 4, line 59; column 8, line 6; column 9, line 8; column 10, line 8; claims 1-8, 10-14 *

2-12

[Right] Researched Technological Areas (Int. Cl.5)

A PATENT ABSTRACTS OF JAPAN, Vol. 9, No. 143 (E-322) (1866),

June 18, 1985; & JP-A-60 025 354 (FUKITSU K.K.)

02/08/1985

* Abbreviated *

2-6, 10

H 04 Q

G 10 L

H 04 B

H 04 L

A US-A-2 650 266 (BROWING)

* Column 2, lines 14-40, 45-52; Figures 1, 2 *

5-7

This report was established for all the claims

Research Location

LA HAYE

Date the research was completed

01/29/1993

Examiner

GRIES T M

CATEGORIES OF LISTED DOCUMENTS

X: Particularly relevant by itself

Y: Particularly relevant in combination with another in the same category

A: Technological background

O: Non-written disclosure

P: Supplemental document

T: theory or principle at the base of the invention

E: Previous patent document, but published at the application date or after that date

D: Quoted in the application

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&: Member of the same family, corresponding document

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EUROPEAN RESEARCH REPORT

Application Number

EP 92 40 3185

DOCUMENTS CONSIDERED RELEVANT

[Left to right]

Category

Document quotation with indication, if necessary, of relevant passages

Related claim

Classification of the request (Int. Cl.5)

A SPEECH COMMUNICATION, Vol. 7, No. 2, July 1988, pages 113-123, Amsterdam, NL; J.E. NATVIG : "Pan-European speech coding standard for digital mobile radio"

* Page 115, indentation 2.4 *

1

A 40th IEEE VEHICULAR TECHNOLOGY CONFERENCE 1990, Orlando, Florida, May 6-9, 1990, pages 323-325, IEEE, New York, US; D. LIN et al.: "Data compression of voiceband modem signals" * Page 323, left column, lines 2-6, 23-27; page 324, left column, lines 21-25, 49-52 *

1

A PATENT ABSTRACTS OF JAPAN, Vol. 7, No. 272 (E-214) (1417), December 3, 1983; & JP-A-58 153 480 (NIPPON DENKI K.K.)

09/12/1983

* Abbreviated *

1

[Right] Researched Technological Areas (Int. Cl.5)

A EP-A-0 258 697 (HITACHI, LTD)

* The whole document *

12

This report was established for all the claims

Research Location

LA HAYE

Date the research was completed

01/29/1993

Examiner

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CATEGORIES OF LISTED DOCUMENTS

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P: Supplemental document

T: theory or principle at the base of the invention

E: Previous patent document, but published at the application date or after that date

D: Quoted in the application

L: Quoted for other reasons

&: Member of the same family, corresponding document

* * *

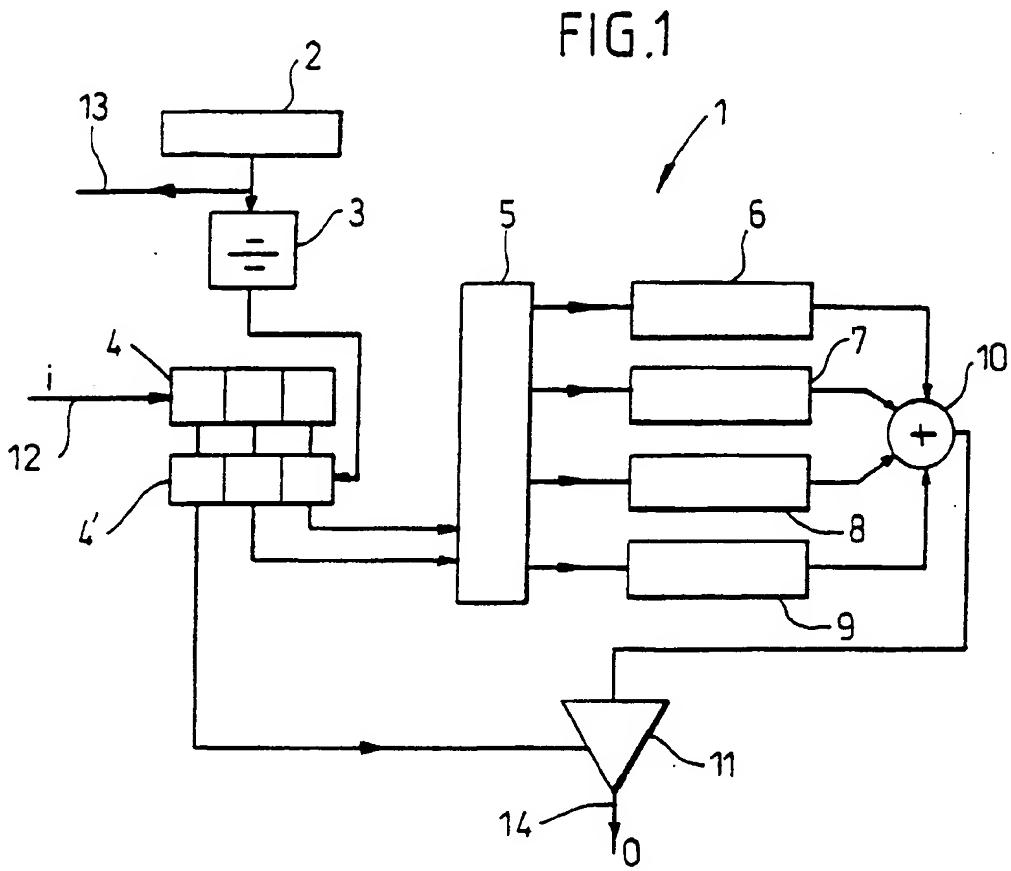
FIG.1
1
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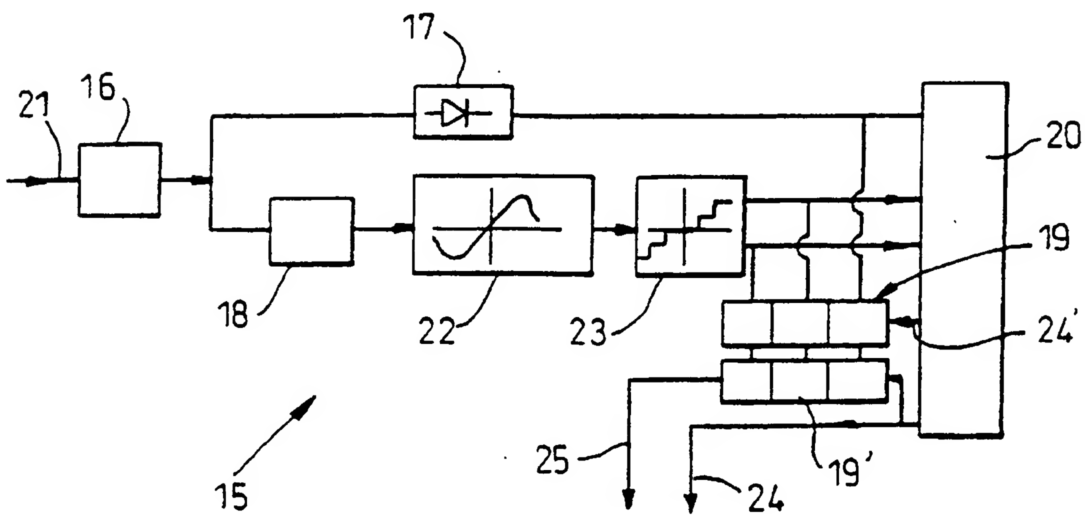
FIG.2
15
16
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24'
25

FIG.3

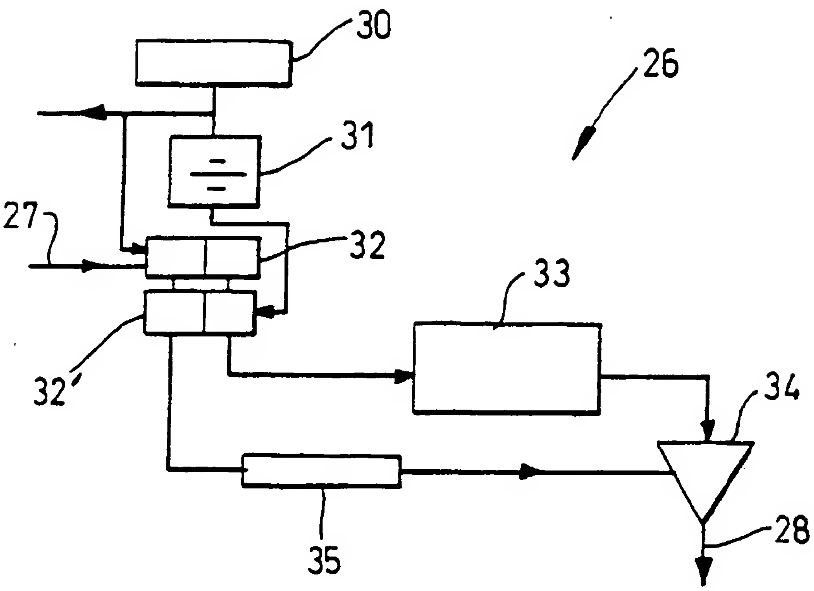

FIG.4